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Spot and future price relationship of black gram and green gram

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Abstract
The present study was undertaken to examine the relationship between spot and future prices and to study the seasonal and cyclical variations in prices of black gram and green gram in selected markets of Maharashtra. Latur and Amravati markets were selected for black gram, whereas Akola and Washim markets were selected for green gram. The study was based on monthly secondary price data for the period 2005-2025. Spot prices were collected from AGMARKNET, while future prices were obtained from NCDEX. The data were analysed using EViews 12. Correlation and regression analyses were employed to examine the relationship between spot and one-month lag future prices, while seasonal indices were estimated using the twelve-month ratio to moving average method and cyclical movements were studied using the residual method. The results showed a positive and significant association between spot and lagged future prices. For black gram, the correlation coefficient between Latur spot and lagged future prices was 0.89, while it was 0.59 for Amravati. For green gram, the corresponding values were 0.93 for Akola and 0.91 for Washim. Regression analysis also showed a positive and significant influence of one-month lagged future prices on spot prices. The regression coefficients were 0.82 and 0.54 for Latur and Amravati, respectively, and 0.79 and 0.76 for Akola and Washim. Seasonal variations were observed in both commodities, with relatively higher indices during September-November for black gram and April-May for green gram. Cyclical fluctuations were also evident with higher movements during 2014-2016 and 2023-2024. The findings indicate that futures prices provide useful signals for spot market movements and futures market has an important role in price discovery.

Keywords: Black gram, Green gram, Spot price, Future price, Price relationship, Price discovery, Seasonality, Cyclical variation

Introduction
Black gram and green gram are important pulse crops in India and contribute significantly to agricultural production, trade, nutritional security and farm income in Maharashtra. India is the largest producer and consumer of pulses. Among pulses, black gram and green gram are major kharif pulses grown in Marathwada and Vidarbha regions. Maharashtra is one of the leading pulse producing states, and Latur is known as the pulse bowl of Maharashtra. These crops also improve soil fertility through nitrogen fixation and fit well in rainfed cropping systems. The prices of agricultural commodities fluctuate over time due to seasonality, weather, demandsupply mismatch, market arrivals, storage, transportation, government policies and market expectations. In case of pulses, price volatility is higher due to gap between demand and supply and high import dependence. This price instability creates risk for farmers, traders, processors and consumers. Farmers face uncertainty about prices they will receive, which affects their sowing and selling decisions and often leads to distress sale. To manage price risk, futures markets have been established. Futures market is an organized exchange where standardized contracts for future delivery are traded. In India, National Commodity and Derivatives Exchange (NCDEX) provides futures trading for agricultural commodities. Futures markets perform two important functions price discovery and price risk management through hedging. Futures prices reflect collective expectations of market participants about future demand, supply and provide advance signals for spot market movements. If futures market is efficient, spot and future prices should be closely related and

integrated. Understanding spot-future relationship is important for farmers to decide when to sell, for traders and dal mill owners to hedge risk, and for policymakers to frame price policies. Similarly, information on seasonal and cyclical variations helps in planning timing of sale, storage and marketing. Although studies exist for cereals and oilseeds, limited work with long period data is available for black gram and green gram in Maharashtra. Therefore, the present study was undertaken to examine spot and future price relationship and seasonal and cyclical variations in selected markets of Maharashtra during 2005-2025.

Objectives

1. To examine the relationship between spot and future prices of black gram and green gram.
2. To study the seasonal and cyclical variations in prices of black gram and green gram.

Methodology

1. Selection of Crop

For the study, two crops i.e. black gram and green gram were selected.

2. Selection of Major Market

The study has been confined to the Maharashtra state. For black gram, Latur and Amravati APMCs were chosen as they are major trading and arrivals centres in Maharashtra. For green gram, Akola and Washim APMCs were selected due to their high trade volume and importance in price discovery.

3. Period of Study

The present study was based on time series monthly data of prices. The data prices of black gram and green gram from the selected APMCs were collected for a period of last 20 years from 2005-2025.

4. Sources of Data

The study was based on secondary data. Spot prices were collected from the official website of the Directorate of Marketing and Inspection, Government of India www.agmarknet.gov.in. The future prices were collected from India's leading agricultural commodity exchange i.e. NCDEX (National Commodity and Derivatives Exchange), the official website of the NCDEX is https://www.ncdex.com. The online portal CEDA (Centre for Economic Data and Analysis) https;//agmarket.ceda.ashoka.edu.in/ was also referred for data verification.

5. Method of Analysis

The collected data were analyzed using EViews 12 statistical software and the results were presented in the tables in order to bring out generalization of facts from which meaningful inference could be drawn.

Analytical Tools

The collected data was analyzed using suitable analytical tools as described below.

A. Relationship between spot and future prices of black gram green

1) Correlation coefficient

To study the relationship between spot and future prices, the method of correlation was used. The correlation is the measure of degree of relationship amongts two series i.e. spot and future. The formula used for calculating the coefficient of correlation is as follow:

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}},$$

Where,
r = correlation coefficient
x, y = two related variable
n = sample size

2) Regression analysis

Regression analysis was carried out to a certain the relationship between spot prices and one month lagged future prices. The simple linear regression model was used for analysis. The equation fitted for the purpose was specified as follows:

$$Y = a + bx + e$$

Where
Y = Spot prices
a = intercept
b = regression coefficient
X = one month lagged future prices

B) Seasonal and Cyclical variations in prices of black gram and green gram

1) Estimation of seasonal Indices of monthly data

Most widely used method of measuring seasonal fluctuations i.e method of moving average was used to calculate seasonal indices. To measure the seasonal variations in spot and future prices, seasonal indices were calculating by employing twelve months ratio to moving average method.

2) Cyclical Indices

The residual method of estimating cyclical movement in time series was used for estimating cyclical indices, after eliminating the seasonal variation and trend components.

Results and Discussion

The data collected were analyzed in relation to each of the specific objectives of the study and results have been tabulated. In this chapter, results of the analysis are presented and discussed in the following section.

- Correlation and Regression analysis
- Seasonal and Cyclical variations in spot and future prices

1 Correlation Regression analysis

1.1 Descriptive statistics

Descriptive Statistics were worked out to study the behaviour and distribution of spot and future prices of black gram and green gram during the study period. The descriptive statistics of Latur, Amravati spot prices and future prices of black gram are presented in Table 1 and The descriptive statistics of Akola, Washim spot prices and future prices of green gram are presented in Table 2.

Table 1: Descriptive statistics of spot and future prices of black gram (Rs/qtl)

Market Prices	N	Mini.	Max.	Mean	Median	Mode	Std. Dev.	C.V %	Skewness	Kurtosis
Latur	252	1440	10383	4643	4398	Nil	1951	42	0.6145	-0.1737
Amravati	252	1380	10348	4298	4046	2316	1917	44	0.5713	-0.3717
Future	252	1599	10839	5004	4512	7167	2103	42	0.4773	-0.5651

It is observed from Table 1 that, the average spot prices of Latur and Amravati markets were Rs. 4643/qtl and Rs. 4298/qtl respectively, whereas the average future price of black gram was Rs. 5004/qtl. The maximum spot prices were Rs. 10383/qtl in Latur and Rs. 10348/qtl in Amravati and minimum were Rs. 1440/qtl and Rs. 1380/qtl, while maximum future price was Rs. 10839/qtl and minimum was Rs. 1599/qtl. The coefficient of variation was 42 per cent for Latur, 44 per cent for Amravati and 42 per cent for future prices, indicating moderate variability during the study period. The skewness values were positive for all markets indicating positively skewed price distribution.

Table 2: Descriptive statistics of spot and future prices of green gram

Market Prices	No. of obs	Mini.	Max.	Mean	Median	Mode	Std. Dev.	C.V %	Skewness	Kurtosis
Akola	252	1734	8543	4834	4931	Nil	1564	32.36	-0.095	-0.8278
Washim	252	1736	8778	4686	4810	4600	1529	32.63	-0.0539	-0.7235
Future	252	1737	8858	5210	5292	Nil	1829	35.11	-0.1797	-1.0499

It is observed from Table 2 that, the average spot prices of Akola and Washim markets were Rs. 4834/qtl and Rs. 4686/qtl respectively, whereas the average future price of green gram was Rs. 5210/qtl. The maximum spot prices were Rs. 8543/qtl in Akola and Rs. 8778/qtl in Washim and minimum were Rs. 1734/qtl and Rs. 1736/qtl, while maximum future price was Rs. 8858/qtl and minimum was Rs. 1737/qtl. The coefficient of variation was 32.36 per cent for Akola, 32.63 per cent for Washim and 35.11 per cent for future prices, indicating considerable variability during the study period. The skewness values were negative for all the selected markets, indicating negatively skewed price distribution.

1.2 Simple Correlation coefficient

The simple correlation analysis was carried out to examine the degree of association between spot prices and one month lag future prices of black gram and green gram. The simple correlation coefficient between spot and lag future prices of black gram and green gram are presented in Table 3 and Table 4.

Table 3: Simple Correlation Coefficient between Spot and lag future prices of black gram

	Simple Correlation Coefficient N = 252, Prob. > | r | under H0: Rho=0		
	Spot Prices (Latur)	**Spot Prices (Amravati)**	**Lag future prices**
Spot prices (Latur)	1	0.65**	0.89**
Spot Prices (Amravati)	0.59**	1	0.59**
Lag future prices	0.89**	0.59**	1

Note - ** indicate significant at 5%

It is observed from Table 3 that, the correlation coefficient between Latur spot prices and lag future prices was 0.89, whereas between Amravati spot prices and lag future prices was 0.59. The correlation coefficient between Latur and Amravati spot prices was 0.65 and all correlations were significant at 5 per cent level. The results indicated a moderate to high positive correlation between spot and lag future prices in both markets. This implies that an increase in future prices is associated with an increase in spot prices, indicating a close relationship between spot and future markets during the study period.

Table 4. Simple Correlation Coefficient between Spot and lag future prices of green gram

	Simple Correlation Coefficient N = 252, Prob. > | r | under H0: Rho=0		
	Spot Prices (Akola)	**Spot Prices (Washim)**	**Lag future prices**
Spot prices (Akola)	1	0.92**	0.93**
Spot prices (Washim)	0.92**	1	0.91**
Lag future prices	0.93**	0.91**	1

Note - ** indicate significant at 5%

It is observed from the table 4 that, the strong positive correlation coefficient between Akola spot and lag future prices was 0.93 and 0.91 between Washim spot and lag future prices. Correlation coefficient between Akola and Washim spot prices was 0.92, all significant at 5% level. This indicates close integration between spot and future markets of green gram during the study period.

1.3 Linear regression analysis

Linear regression analysis was carried out to examine the effect of one month lag future prices on spot prices of black gram and green gram. The estimated regression coefficients are presented in Table 5 and Table 6.

Table 5: Parameter estimation of linear regression analysis of spot and one month lag future prices of black gram

Variable	Parameter Estimate	Standard Error	T Value	Pr > | t |
		Latur		
Intercept (C)	526.762	(142.60)	3.6939	< 0.0003
Future one month Lag prices (X)	0.82*	(0.026318)	31.40	< 0.0001
		Amravati		
Intercept (a)	1586.95	(250.0478)	6.348695	< 0.0001
Future one month Lag prices (X)	0.54*	(0.046148)	11.81298	< 0.0001

Note - ** indicate significant at 5%

It is observed from the Table 5 the regression coefficient of one-month lag future price was 0.82 for Latur and 0.54 for Amravati, both positive and significant at 10% level. Intercepts were 526.76 and 1586.95 respectively. This indicates that lag future prices have significant positive influence on spot prices, where 10% increase in future price raises spot price by 0.82% in Latur and 0.54% in Amravati.

Table 6: Parameter estimation of linear regression analysis of spot and one month lag future prices of green gram

Variable	Parameter Estimate	Standard Error	T Value	Pr > | t |
		Akola		
Intercept (C)	726.63	(108.26)	6.71	<0.0001
Future one month Lag prices (X)	0.79**	0.02)	40.34	< 0.0001
		Washim		
Intercept (a)	743.59	(118.08)	6.30	< 0.0001
Future one month Lag prices (X)	0.76**	(0.02)	35.51	< 0.0001

It is observed from Table 6 the regression coefficient of one-month lag future price was 0.79 for Akola and 0.76 for Washim, both positive and significant at 5% level. Intercepts were 726.63 and 743.59 respectively. This shows lag future prices have significant positive influence on green gram spot prices, with Akola responding more strongly to future price changes than Washim.

Seasonal and Cyclical variations in spot and future prices

Seasonal Variations

The seasonal indices of spot and future prices of black gram and green gram were worked out to study the seasonal variations in prices during different months of the year. The seasonal indices for black gram and green gram are presented in Table 7 and Table 8.

Table 7: Seasonal Indices for spot and future prices of black gram

Sr. No.	Months	Latur	Amravati	Future
1	Jan	98.04	94.86	94.82
2	Feb	97.31	95.46	94.72
3	Mar	96.13	97.04	98.88
4	Apr	95.68	97.68	101.99
5	May	98.50	98.14	103.02
6	Jun	98.40	97.96	101.27
7	Jul	89.01	99.53	101.04
8	Aug	99.94	103.62	103.80
9	Sep	107.08	108.25	100.88
10	Oct	105.90	102.39	99.36
11	Nov	109.32	103.30	101.28
12	Dec	104.62	101.72	98.87

It observed from Table 7 that in Latur market, the highest seasonal index was recorded during November (109.32), followed by September (107.08), followed by October (105.90) and December (104.62) while the lowest seasonal index was observed during July (89.01). In Amravati market, the highest seasonal index was recorded during September (108.25), followed by November (103.30), followed by October (102.39) and December (101.72), whereas the lowest seasonal index was observed during January (94.86). similarly, the highest seasonal index was observed in future markets the month of August (103.80), followed by May (103.03), followed by April (101.99), followed by November (101.28), followed by June (101.27), followed by July (101.04) and September (100.88), Whereas the lowest in February (94.72). The result indicated that seasonal variations existed in both spot and future prices of black gram during the study period.

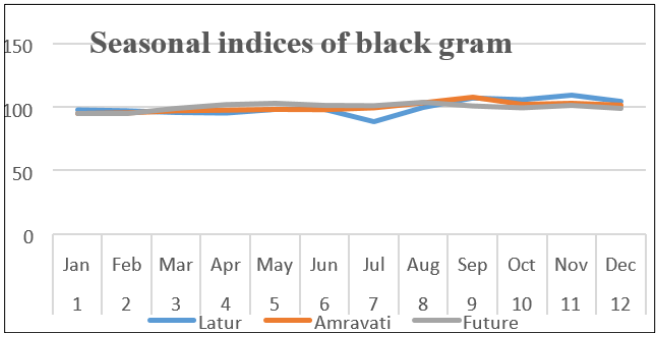

Fig 1: Seasonal indices of black gram

Table 8: Seasonal Indices for spot and future prices of black gram

Sr. No	Months	Akola	Washim	future
1	Jan	98.86	98.55	99.09
2	Feb	98.07	100.78	99.77
3	Mar	96.29	99.76	101.79
4	Apr	104.53	100.67	104.92
5	May	103.54	99.03	103.20
6	Jun	99.18	100.78	97.55
7	Jul	97.34	99.88	97.76
8	Aug	97.13	101.52	98.42
9	Sep	99.90	101.04	96.64
10	Oct	101.06	99.80	98.58
11	Nov	102.70	100.11	101.40
12	Dec	101.34	98.02	100.84

It is observed from Table 8 that in Akola market, the highest seasonal index was recorded during April (104.53), followed by May (103.54), followed by November (102.70), followed by December (101.34), followed by (101.34), whereas lowest during March (96.29). In washim markets, the highest seasonal index was recorded during August (101.52), followed by September (101.04), followed by February, March (100.78), followed by April (100.67) and November (100.11), whereas lowest during December (98.02). similarly, in the future highest seasonal index was recorded during April (104.92), followed by May (103.20), followed by November (101.40) and December (100.84), whereas lowest during June (97.55). The result indicate that seasonal fluctuation existed in both spot and future prices of green gram during the study period.

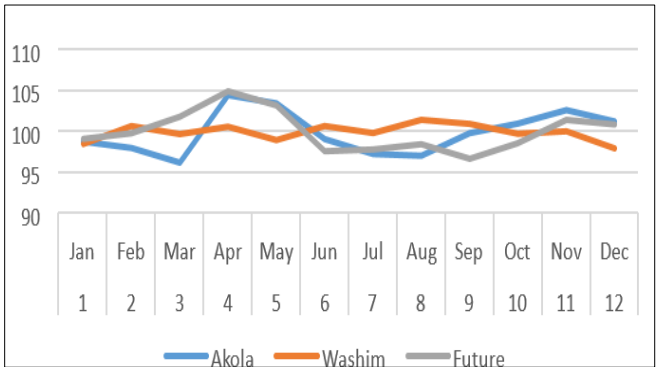

Fig 2: Seasonal indices of green gram

2.2 Cyclical Variations

The cyclical variations of spot and future market prices of black gram and green gram were work out to study the cyclical variations in prices during the study period. The cyclical variations of spot and future prices of black gram and green gram are presented in table 9 and table 10.

Table 9: Cyclical indices for spot and future prices of black gram

Sr. No	Year	Latur	Amravati	Future
1	2005	75.46	81.99	86.25
2	2006	112.38	110.21	115.83
3	2007	79.94	84.31	86.18
4	2008	75.75	66.14	75.31
5	2009	105.95	111.95	103.25
6	2010	106.00	113.35	114.69
7	2011	92.57	89.79	94.52
8	2012	86.26	85.06	86.99
9	2013	87.02	103.61	81.75
10	2014	120.40	178.05	102.29
11	2015	171.59	169.49	149.23
12	2016	159.20	75.15	168.31
13	2017	88.12	68.08	90.90
14	2018	65.07	89.78	69.16
15	2019	89.69	81.75	81.50
16	2020	86.12	76.99	97.98
17	2021	99.78	89.36	96.34
18	2022	90.12	113.67	91.35
19	2023	118.93	112.05	106.54
20	2024	104.90	101.96	109.65
21	2025	84.67	97.16	91.92

It is observed from Table 9 that the cyclical variations were observed in spot and future prices of black gram during the study period. The higher prices of both spot as well as future markets were noted in the year of 2006,2009, 2010, 2014, 2015, 2016, 2023 and 2024. The lowest prices of both spot as well as future market noted in 2005. The results indicated that cyclical fluctuations existed in spot and future prices of green gram throughout the study period.

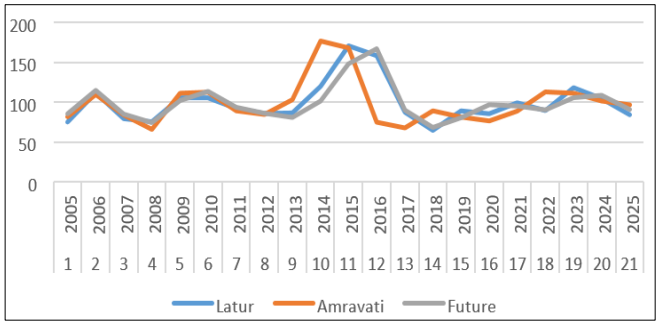

Fig 3: Cyclical indices of black gram

Table 10: Cyclical indices for spot and future prices of green gram

Sr. No	Year	Akola	Washim	Future
1	2005	76.68	80.41	83.31
2	2006	95.37	94.00	99.87
3	2007	72.99	75.04	78.07
4	2008	73.37	76.03	75.75
5	2009	116.23	121.10	111.83
6	2010	121.76	121.77	117.31
7	2011	92.88	89.67	92.11
8	2012	98.27	93.40	96.76
9	2013	111.05	112.14	106.41
10	2014	136.30	139.46	127.50
11	2015	147.09	144.63	140.13
12	2016	111.16	103.34	114.63
13	2017	82.81	85.71	85.64
14	2018	84.64	84.35	84.69
15	2019	95.32	95.11	93.79
16	2020	96.41	94.99	103.89
17	2021	88.54	93.26	93.43
18	2022	93.89	95.30	92.41
19	2023	108.01	110.61	106.92
20	2024	104.28	99.12	103.17
21	2025	92.87	90.45	92.27

It observed from Table 10 that the higher prices of both spot as well as future markets were noted in the years 2009, 2010, 2013, 2014, 2015, 2016, 2023 and 2024. Whereas, the lowest prices were noted in 2005, 2007 and 2008 for Akola, Washim and future markets. The result indicated that cyclical fluctuations existed in spot and future prices of green gram through out the study period.

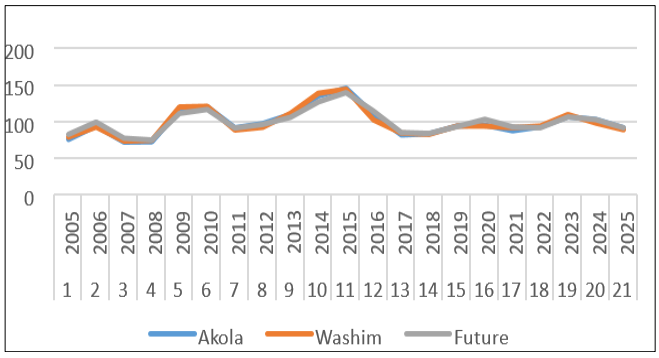

Fig 4: Cyclical indices of green gram

Conclusions

The study concluded that spot and future prices were positively and significantly related with strong correlation in Latur, Akola and Washim, and onemonth lag futures significantly influenced current spot prices, indicating futures market performs price discovery. Highest seasonal indices were observed in Sep-Nov for black gram and Apr-May for green gram and cyclical highs during 2014-16 and 2023-24. Hence, greater awareness on futures trading, market information and storage facilities can help manage price risk effectively.

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